

## Homework #6 • MATH 419 • FFT & Legendre Polynomials

- for this week, you may submit your write-up on **Thursday 07 July**.

**A) An FFT Evaluation of the Legendre Polynomials** (3 pages) Download the practice script `fftttest.m` and see that you understand how the discrete Fourier modes  $e^{ikx}$  are numerically treated. Then consider the function

$$f(x) = \frac{1}{\sqrt{1 - ze^{ix} + e^{2ix}/4}} \quad (1)$$

where  $-1 < z < +1$  is a real parameter. Using the FFT, verify that the Fourier series for  $f(x)$  seems to be

$$F(x) = \sum_{j=0}^{\infty} 2^{-j} P_j(z) e^{ijx} \quad (2)$$

by showing (spectral) convergence of the first few  $P_j(z)$  as the number of DFT modes (N) gets large. You can calculate an error using Matlab's evaluation of the Legendre polynomials (`help legendre`, you are only interested in the first value).

**Bonus:** With a little research (or google), discover what trick is being invoked in this exercise.

